# Space Weather Technical Forecast

Issued on Friday, 18 March 2022 at 00:50 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Slight chance of G1 minor geomagnetic storms on day 3 (20th March). Slight chance of isolated M-Class flares.

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar Activity has been Low with just two C1 flares, at 17/0155 UTC and 17/1918 UTC respectively. There are currently three numbered sunspot regions on the visible disc; AR2965 (Beta-Gamma) located in the northwest quadrant, remains the most complex though with decay observed in some of the minor intermediate spots, AR2967 in the northeast quadrant remains a simple Hsx/Alpha type, and AR2971 remains a small, weak and barely visible Bxo/beta.

No CME's thought to be Earth-directed CMEs were observed in available imagery.

**Solar Wind / Geomagnetic Activity:** Solar winds, as observed by DSCOVR at L1, remained at background levels, with a peak of 388 km/s at 17/0012 UTC and then gradually declined to end the period around 320 km/s. Density was at average to below average levels, around 3-7 ppcc. The strength of the interplanetary magnetic field (IMF), Bt, was weak 3-5nT. The north-south component, Bz, was weak and ranged from -4nT to +3nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background. The high energy electron flux (greater than 2 MeV) has risen from predominantly background to generally moderate levels, peaking at 282 pfu at 17/1640 UTC. The 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, but with a rising trend. Observed fluence at 18/0000 UTC was 5.96e6 integrated pfu.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is expected to be at mostly Low or Very Low levels with an ongoing slight chance of an isolated M-class flare, mainly from AR2965.

**Solar Wind / Geomagnetic Activity:** The CME from the filament eruption on March 16th may give a glancing blow on day 3 (20th March). Also, the next potential coronal hole fast wind arrival is likely to be during day 3 (20th March) from CH66/-, a northern extension of the southern crown coronal hole. Geomagnetic activity is expected to be mostly Quiet (Kp 0-2) with a chance of isolated Unsettled (Kp 3) intervals until days 3 and 4 when there is an increased likelihood of Active (Kp 4) intervals, and a chance of G1/minor geomagnetic (Kp 5) storms on day 3.

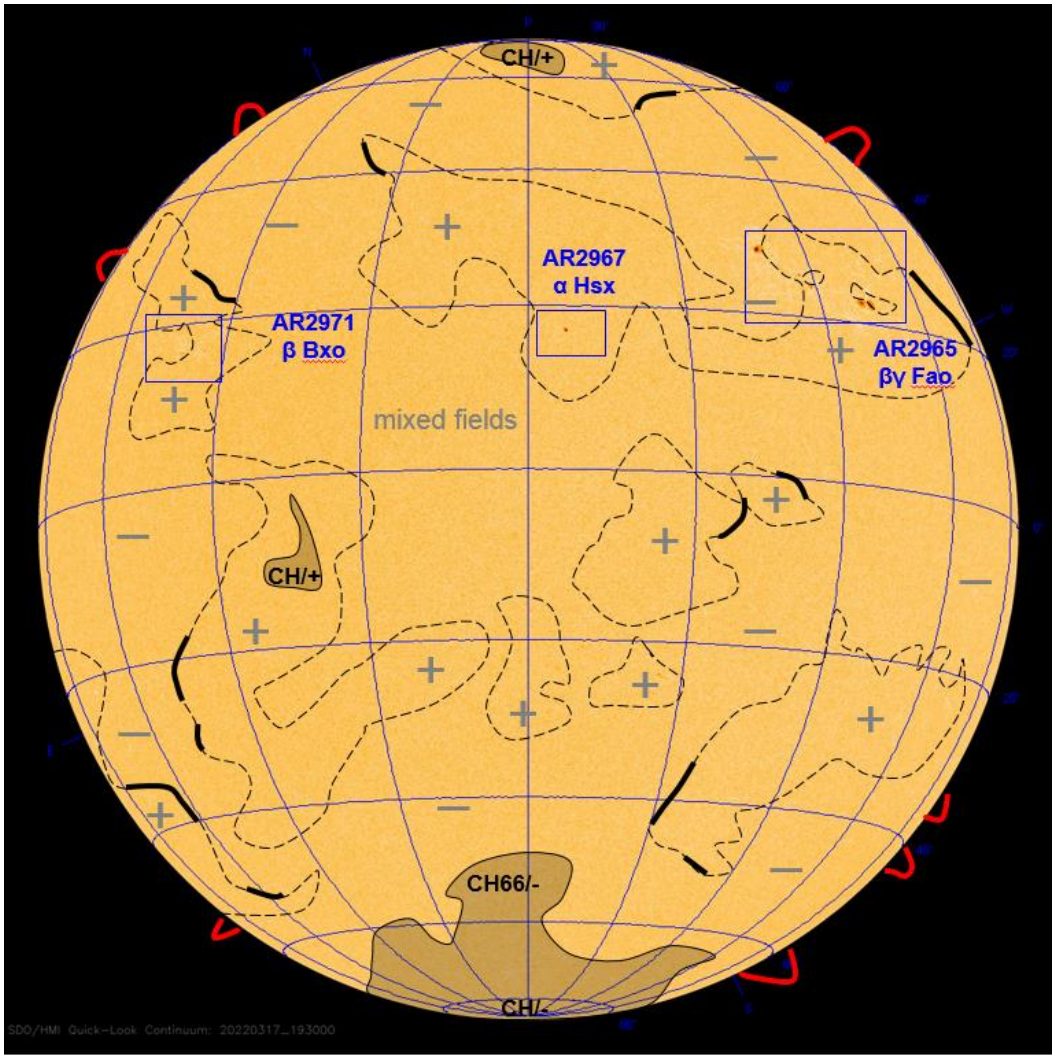
**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels, although there is a slight chance of an increase in response to any larger flares that may occur.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

The high energy (greater than 2 MeV) electron flux is currently at predominantly moderate levels. No definite sources of enhancement are currently expected in the period until the next coronal hole high speed stream from CH66/- arrives, most likely day 3 (20th). The electron fluence is currently well below the Active level, and expected to remain below the Active threshold, but with a continued rising trend.

**Figure 1. Solar Analysis Valid 17/1930 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

## Geomagnetic Storms:

Solar winds are currently at background levels. A CME was expected to pass to the south of Earth yesterday (17th), from a filament lift-off on the 13th. There is still a small chance over the next few hours of this CME brushing Earth, generating a chance of Unsettled to Active intervals and a very slight chance of G1 Minor Storm intervals.

The CME from the filament eruption in the east on March 16th may give a glancing blow on day 3 (20th March). Also, the next potential coronal hole fast wind arrival is likely to arrive during day 3 (20th March) from CH66/-, a northern extension of the southern crown coronal hole. However, confidence is low regarding this features as a significant HSS has not been captured at Stereo-A.

Yesterday evening (17th) a CME was seen in Lasco imagery, but not Stereo-A. Therefore this CME is unlikely to be Earth directed, as it appears to have originated from just behind the southwest limb. However, analysis will be undertaken to confirm there is no Earth directed component.

Geomagnetic activity is expected to be mostly Quiet (Kp 0-2) with a chance of isolated Unsettled (Kp 3) intervals until days 3 and 4 when there is an increased likelihood of Active (Kp 4) intervals, and a chance of G1/minor geomagnetic (Kp 5) storms on day 3.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 5 | 1 | 30 | 20 |
| Strong | G3 | No | 1 | 1 | 2 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

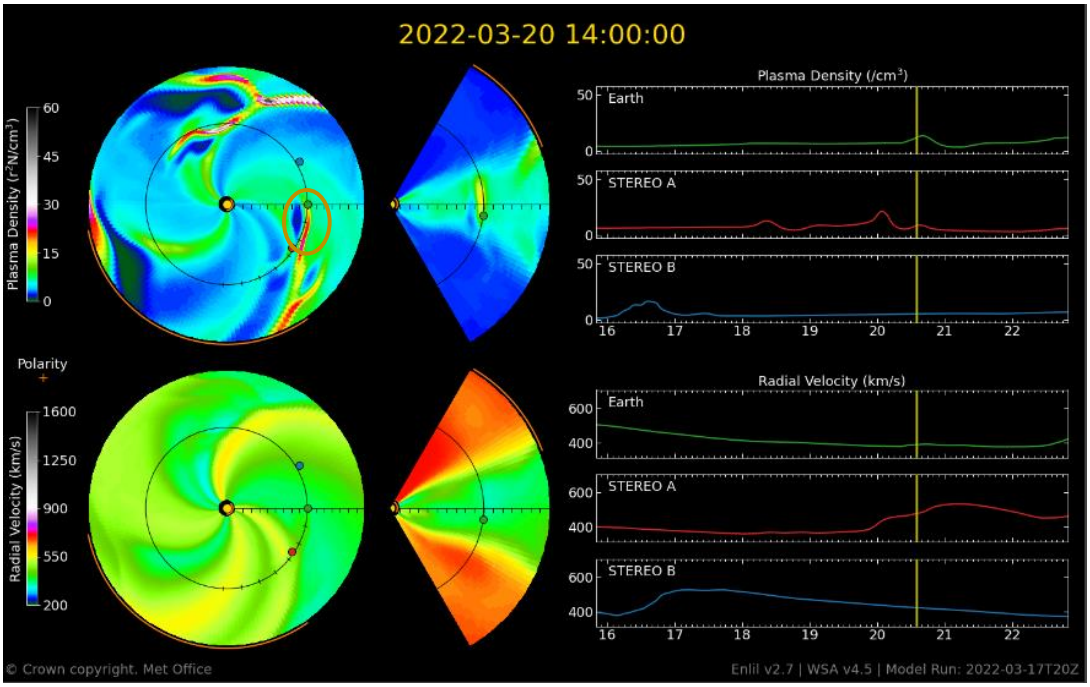
## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 16/2020 UTC | Partial | Filament eruption | NE quadrant | 400 | 20/1500UTC | Glancing blow. Limited shock expected. |

**Figure 2: Met Office ENLIL model showing the potential glancing blow on 20th.**

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.




## Radio Blackouts - X-Ray Flares:

Solar Activity has been Low with just two C1 flares, at 17/0155 UTC and 17/1918 UTC respectively. There are currently three numbered sunspot regions on the visible disc; AR2965 (Beta-Gamma) located in the northwest quadrant, remains the most complex though with decay observed in some of the minor intermediate spots, AR2967 in the northeast quadrant remains a simple Hsx/Alpha type, and AR2971 remains a small, weak and barely visible Bxo/beta.

STEREO-A imagery shows possible returning regions which may rotate onto the east limb over the next few days.

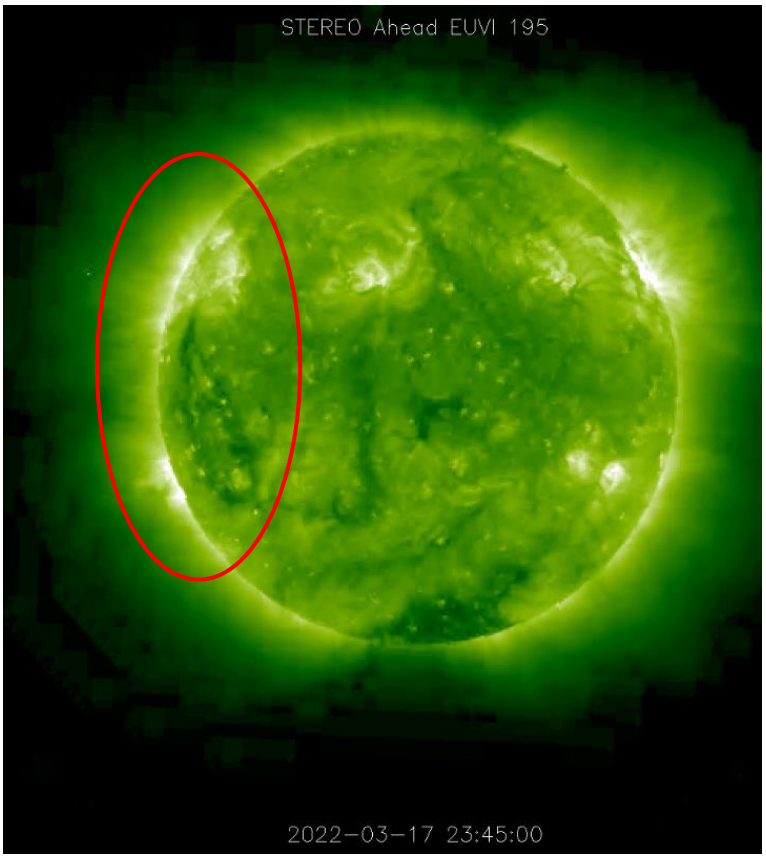
Solar activity is forecast to continue mostly Very Low or Low with a slight chance of isolated M-class flares, with AR2965 the likely source.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 15 | 15 | 15 | 15 |
| Very Active | R3 to R5 X Class | No | 1 | 1 | 1 | 1 |

**Figure 3: STEREO-A EUVI 195 image showing potential regions currently on the far side.**

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.




## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 has remained at background levels. Any significant flares from AR2965 may give a potential enhancement, however only a slightly chance of reaching the S1 level is currently forecast. Otherwise background levels are expected to persist.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 5 | 5 | 5 | 5 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

## High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at predominantly moderate levels. No definite sources of enhancement are currently

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

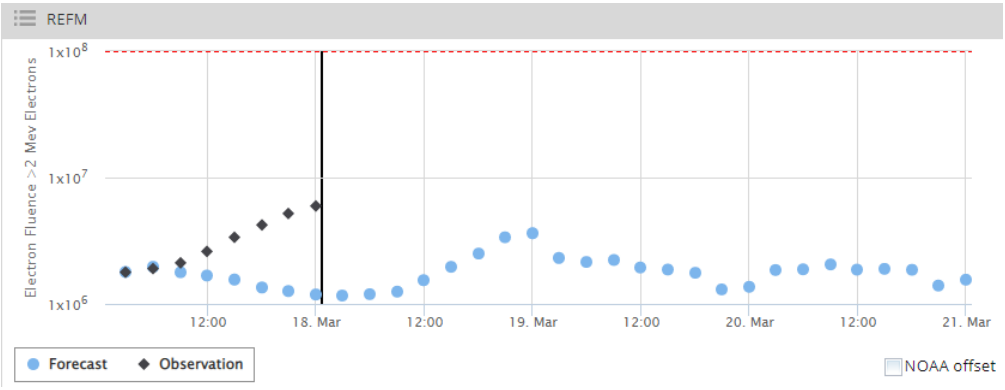
© Crown Copyright 2022. All Rights Reserved.

expected in the period until the next coronal hole high speed stream from CH66/- arrives, most likely day 3 (20th).
The electron fluence is currently well below the Active (1e8 integrated flux) level, and expected to remain below the Active threshold, but with a continued rising trend.

The Met Office REFM model is currently underestimating the fluence, and with a flat rather than rising trend, but does keep the fluence below the Active threshold over the next three days. Therefore the REFM model is considered to be offering good guidance.

| GEO Electron Environment | Level ($cm^{-2}\,sr^{-1}\,day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 5 | 10 | 20 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

**Figure 4: Met Office REFM model.**




Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.